

Stereo Vision Introduction

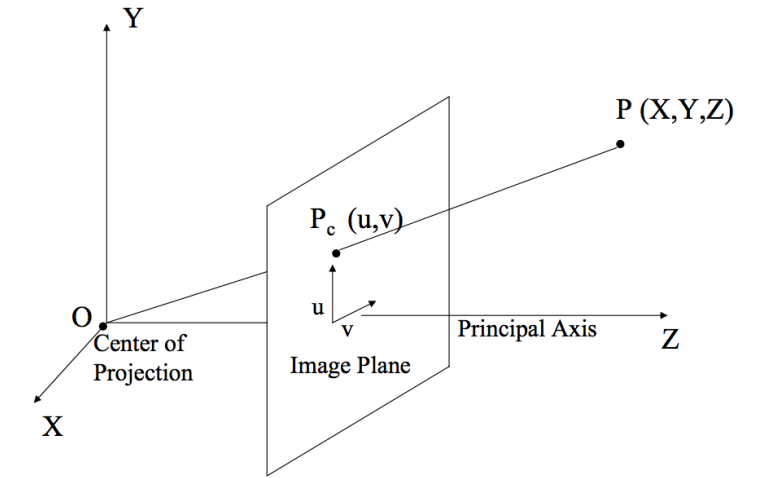
Spectralink

Camera Calibration

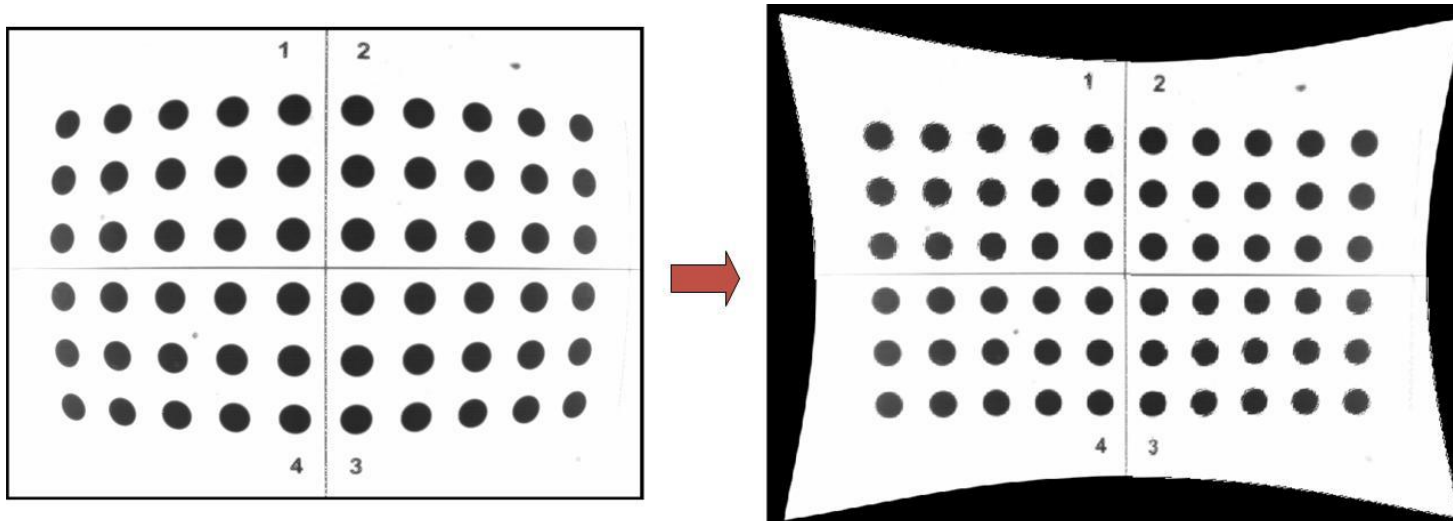
- Single Camera
- Dual Camera
- Camera Matrix
- Distortion Coefficients
- Essential Matrix

Single Camera Calibration

- Camera Matrix
- Distortion Coefficients



<https://prateekvjoshi.files.wordpress.com/2014/05/3-pinhole-camera-geometry.png>



<http://www.ntu.edu.sg/home/assklam/images/distortion-correction.jpg>

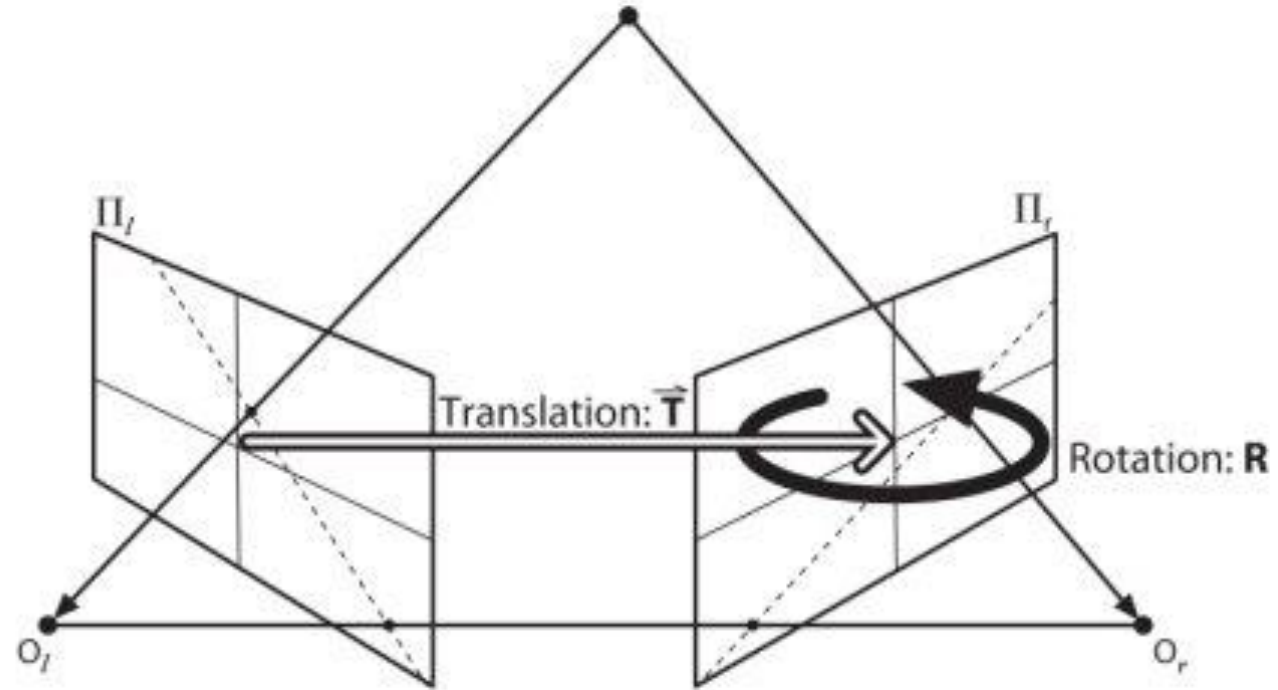
$$s \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f_x & 0 & c_x \\ 0 & f_y & c_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} r_{11} & r_{12} & r_{13} & t_1 \\ r_{21} & r_{22} & r_{23} & t_2 \\ r_{31} & r_{32} & r_{33} & t_3 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \\ 1 \end{bmatrix}$$

2D Image Coordinates Intrinsic properties (Optical Centre, scaling) Extrinsic properties (Camera Rotation and translation) 3D World Coordinates

https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwihyem21rPdAhUGzoMKHX6mDasQjRx6BAGBEAU&url=https%3A%2F%2Fwww.cc.gatech.edu%2Fclasses%2FAY2016%2Fcs4476_fall%2Fresults%2Fproj3%2Fhtml%2Fagartia3%2Findex.html&psig=AOvVaw1P-2AvnHMNLjunLLvF6wI0&ust=1536780024905156

Dual Camera Calibration

- Essential Matrix



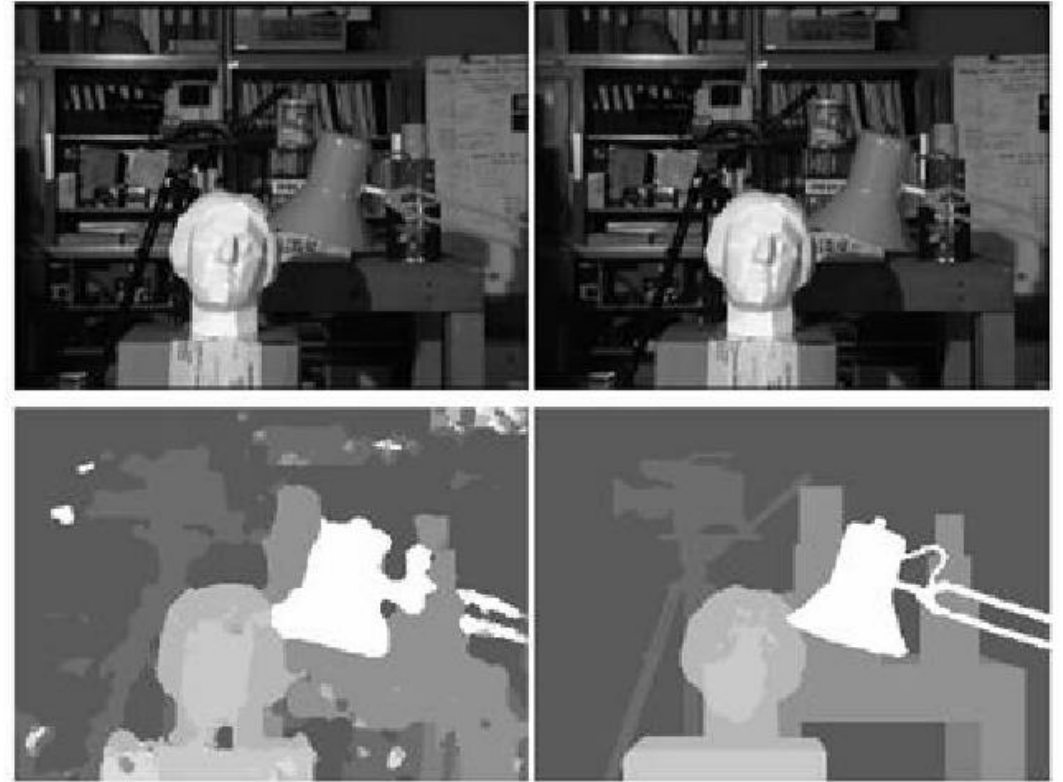
https://docs.opencv.org/3.0-beta/_images/essential_matrix.jpg

Depth Mapping

- Disparity Maps
- Correspondence (SIFT)
 - Points of interest
 - Matching
 - Spatial vs. Temporal
- Depth Calculation

Disparity Maps

- Difference between two images
 - For every pixel, find corresponding pixel and measure distance.
 - This is the value of that pixel on the disparity map
- This is the GOAL



https://www.researchgate.net/profile/Manuel_Dominguez-Morales/publication/229592067/figure/fig1/AS:300836493250585@1448736417665/Disparity-map-and-Depth-map-for-a-concrete-stereo-scene.png

Correspondence

- Many different algorithms
- SIFT (Scale Invariant Feature Transform)
 - Points of Interest
 - Matching
- Spatial (different POV)
- Temporal (same POV)

Depth Calculation

- Disparity is proportional to depth
- Depends on calibration

Velocity Calculation

- Temporal Correspondence